

SEQUENCE LISTING

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<150> EP 02255203.8

<151> 2002-07-25

<160> 17

<170> PatentIn version 3.1

<210> 1

<211> 2586

<212> DNA

<213> Propionibacterium freudenreichii

<220>

<221> CDS

<222> (1) .. (2586)

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cgg	gcc	tcg	ggg	cgc	agc	gtg	gcc	gga	ttc	aag	gtg	ggc	ccc	gac	tac	144
Arg	Ala	Ser	Gly	Arg	Ser	Val	Ala	Gly	Phe	Lys	Val	Gly	Pro	Asp	Tyr	
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Ile	Asp	Pro	Gly	Tyr	His	Ala	Leu	Ala	Cys	Gly	Arg	Pro	Gly	Arg	Asn	
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ctg	gat	ccc	tat	ttg	tgc	ggg	ccc	gag	cgc	att	gcg	ccg	ttg	ttc	gcc	240
Leu	Asp	Pro	Tyr	Leu	Cys	Gly	Pro	Glu	Arg	Ile	Ala	Pro	Leu	Phe	Ala	
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His	Gly	Ala	Leu	His	Pro	Glu	Pro	Ala	Asp	Ile	Ser	Val	Val	Glu	Gly	
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gtg	atg	ggc	atg	ttc	gac	ggc	aag	ctc	ggc	gcg	tgg	ccc	gac	ggc	acc	336
Val	Met	Gly	Met	Phe	Asp	Gly	Lys	Leu	Gly	Ala	Trp	Pro	Asp	Gly	Thr	
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Asp	Asp	Pro	Ala	Gly	Phe	Gly	Ser	Ser	Ala	His	Ile	Ala	Arg	Leu	Leu	

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gtg gcc ggc gtc atc ctc aat cgg gtg atg ggt gcc cgc gtg gtc gac Val Ala Gly Val Ile Leu Asn Arg Val Met Gly Ala Arg Val Val Asp 165 170 175			528
gag atc acc cgg ggc tgc gca cgt gtc ggc ctg ccg gtg ctg ggg gct Glu Ile Thr Arg Gly Cys Ala Arg Val Gly Leu Pro Val Leu Gly Ala 180 185 190			576
ctg ccg aaa agc acg cgg gtg gcc gtg ggc tca cgc cac ctg gga ctg Leu Pro Lys Ser Thr Arg Val Ala Val Gly Ser Arg His Leu Gly Leu 195 200 205			624
gtc acg gcc gac gag cag ggt gac gcg atc ggc atc gtg cag cag gcc Val Thr Ala Asp Glu Gln Gly Asp Ala Ile Gly Ile Val Gln Gln Ala 210 215 220			672
ggt gag ctc gtc gcc gca cac ctc gac ctc gac gcc atc gcc acg atc Gly Glu Leu Val Ala Ala His Leu Asp Leu Asp Ala Ile Ala Thr Ile 225 230 235 240			720
gcc ggt ggg gcc cct gac ctg gcc gtc gat ccc tgg gat ccc gcc gca Ala Gly Gly Ala Pro Asp Leu Ala Val Asp Pro Trp Asp Pro Ala Ala 245 250 255			768
gag gtc gaa ccg gta ccg ggg cgt ccg gtc atc gcc atg gcc tcg ggt Glu Val Glu Pro Val Pro Gly Arg Pro Val Ile Ala Met Ala Ser Gly 260 265 270			816
ccc gca ttc acc ttc cgg tac acc gaa acc gca gaa ctg ctg gag gcg Pro Ala Phe Thr Phe Arg Tyr Thr Glu Thr Ala Glu Leu Leu Glu Ala 275 280 285			864
gcc ggc tgc cgg gtg acg gcc ttc gat ccg ctc acc gcc cgg gcc ctt Ala Gly Cys Arg Val Thr Ala Phe Asp Pro Leu Thr Ala Arg Gly Leu 290 295 300			912
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ctc tac ctg tgc cgc agc ctg gat gga ctg gcg atg gcc ggg gtg gtc			1104

Leu	Tyr	Leu	Cys	Arg	Ser	Leu	Asp	Gly	Leu	Ala	Met	Ala	Gly	Val	Val		
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Asp	Ala	Asp	Ser	Ser	Met	Thr	Pro	Arg	Leu	Thr	Ile	Gly	Tyr	His	His		
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His	Trp	Ala	Gly	Ser	Pro	Val	Leu	Ala	Gln	Arg	Phe	Ala	Arg	Ala	Ala		
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Asn Ala Gly Arg Pro Val Gly Arg Leu Val Leu His Ala Ser Asp Gly	
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Phe Gln Phe Asp His Glu Leu Leu Asp Pro Arg Ala Asp Met Val Val	
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Ile Gly Asn Pro Thr Asn Pro Thr Gly Val Leu His Ser Ala Ala Ser	
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Phe Met Asp Ala Val Pro Gly Glu Pro Glu Ser Leu Ile Gly Ala Arg	
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Val Thr Ala Arg Glu Cys Ser Thr Pro Arg Ala Val Glu Gln Ala Thr	
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Leu Ala Gly Ile Gly Ile Gln Thr Val Gly Glu Ala Arg Ala Pro Phe	
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Val Leu Val Asp Leu Arg Ala His Pro Pro Gly Gly Leu Arg Ala Gly	
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Leu Arg Thr Leu Gly Phe Thr Val Arg Ser Gly Glu Ser Phe Pro Gly	
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ctg ggc gcg ggc tgg ttg cgg ctc gcg gtt cgc cac ccg gac atc agc	2496
Leu Gly Ala Gly Trp Leu Arg Leu Ala Val Arg His Pro Asp Ile Ser	
820 825 830	

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 35 40 45
 Ile Asp Pro Gly Tyr His Ala Leu Ala Cys Gly Arg Pro Gly Arg Asn
 50 55 60
 Leu Asp Pro Tyr Leu Cys Gly Pro Glu Arg Ile Ala Pro Leu Phe Ala
 65 70 75 80
 His Gly Ala Leu His Pro Glu Pro Ala Asp Ile Ser Val Val Glu Gly
 85 90 95
 Val Met Gly Met Phe Asp Gly Lys Leu Gly Ala Trp Pro Asp Gly Thr
 100 105 110
 Asp Asp Pro Ala Gly Phe Gly Ser Ser Ala His Ile Ala Arg Leu Leu
 115 120 125
 Asp Ala Pro Val Leu Leu Val Val Asp Gly Ser His Ser Ala Arg Thr
 130 135 140
 Ala Ala Ala Leu Cys His Gly Leu Ala Ser Tyr Asp Pro Arg Ile His
 145 150 155 160
 Val Ala Gly Val Ile Leu Asn Arg Val Met Gly Ala Arg Val Val Asp
 165 170 175
 Glu Ile Thr Arg Gly Cys Ala Arg Val Gly Leu Pro Val Leu Gly Ala
 180 185 190
 Leu Pro Lys Ser Thr Arg Val Ala Val Gly Ser Arg His Leu Gly Leu
 195 200 205
 Val Thr Ala Asp Glu Gln Gly Asp Ala Ile Gly Ile Val Gln Gln Ala
 210 215 220
 Gly Glu Leu Val Ala Ala His Leu Asp Leu Asp Ala Ile Ala Thr Ile

225		230		235		240
Ala Gly Gly Ala Pro Asp Leu Ala Val Asp Pro Trp Asp Pro Ala Ala						
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Glu Val Glu Pro Val Pro Gly Arg Pro Val Ile Ala Met Ala Ser Gly						
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Pro Ala Phe Thr Phe Arg Tyr Thr Glu Thr Ala Glu Leu Leu Glu Ala						
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Ala Gly Cys Arg Val Thr Ala Phe Asp Pro Leu Thr Ala Arg Gly Leu						
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Pro Ala Asp Val Ser Gly Leu Tyr Leu Gly Gly Gly Phe Pro Glu Glu						
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His Ala Glu Ala Leu Ala Gly Asn Thr Ser Leu Gly Ala Glu Ile Ala						
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Ser Arg Val Ser Glu Gly Leu Pro Thr Val Ala Glu Cys Ala Gly Leu						
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Leu Tyr Leu Cys Arg Ser Leu Asp Gly Leu Ala Met Ala Gly Val Val						
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Asp Ala Asp Ser Ser Met Thr Pro Arg Leu Thr Ile Gly Tyr His His						
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Ala Arg Ala Ala Asn Asp Ser Phe Leu Met Arg Ala Gly Glu Arg Tyr						
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Arg Asp Pro Gly Pro Gln Arg Leu Gly Asp Gln Arg Leu Ala Trp Asp						
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Val Glu Thr Pro Thr Gly Gly Asn Arg Pro Glu Gly Val Leu Val Ala						
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Pro Thr Pro Gly Ser Ala Pro Ser Val His Ala Ser Tyr Gln His Leu						
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His Trp Ala Gly Ser Pro Val Leu Ala Gln Arg Phe Ala Arg Ala Ala						
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Ser Glu Tyr Gly His Thr Gly His His Ser Pro Arg Pro Ala Ala Thr						
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Thr Pro Gly Asp Ala Leu Ser Ala Ala Pro Asp Leu Thr His His Gly						
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Asp Arg Asp Val Leu Pro Gly Leu Val Asp Leu Ala Val Asn Val Arg						
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Asp Val Arg Pro Pro Ala Trp Leu Val Glu Arg Ile Val Ala Ser Ser						
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 Ala Leu Arg His Gly Val Asn Pro Asp Gln Val Leu Leu Thr Ala Gly
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 Ser Ser Glu Ala Phe Ser Leu Ile Ala His Gly Phe Ser Pro Arg Trp
 580 585 590
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 Asn Ala Gly Arg Pro Val Gly Arg Leu Val Leu His Ala Ser Asp Gly
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 Phe Gln Phe Asp His Glu Leu Leu Asp Pro Arg Ala Asp Met Val Val
 625 630 635 640
 Ile Gly Asn Pro Thr Asn Pro Thr Gly Val Leu His Ser Ala Ala Ser
 645 650 655
 Leu Arg Ala Leu Cys Arg Pro Gly Arg Val Val Val Val Asp Glu Ala
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 Phe Met Asp Ala Val Pro Gly Glu Pro Glu Ser Leu Ile Gly Ala Arg
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 Met Asp Gly Leu Leu Val Thr Arg Ser Phe Thr Lys Thr Trp Ser Val
 690 695 700
 Pro Gly Leu Arg Ile Gly Tyr Val Val Gly Asp Pro Ala Leu Ile Arg
 705 710 715 720
 Val Leu Ala His Glu Gln Pro Cys Trp Pro Ile Ser Thr Pro Ala Leu
 725 730 735
 Val Thr Ala Arg Glu Cys Ser Thr Pro Arg Ala Val Glu Gln Ala Thr
 740 745 750
 Ser Asp Ala Arg Gln Ala Ala Gln Asp Arg Arg His Leu Val Ala Arg
 755 760 765
 Leu Ala Gly Ile Gly Ile Gln Thr Val Gly Glu Ala Arg Ala Pro Phe
 770 775 780
 Val Leu Val Asp Leu Arg Ala His Pro Pro Gly Gly Leu Arg Ala Gly
 785 790 795 800
 Leu Arg Thr Leu Gly Phe Thr Val Arg Ser Gly Glu Ser Phe Pro Gly
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 Leu Gly Ala Gly Trp Leu Arg Leu Ala Val Arg His Pro Asp Ile Ser
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 <213> *Propionibacterium freudenreichii*

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 Ser Gly Leu Gly Ala Arg Gln Arg Pro Ala Arg Thr Leu Val Thr Gly
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 Gly Ala Arg Ser Gly Lys Ser Ser Tyr Ala Glu Ala Leu Leu Gly Ser
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 Phe Asp His Val Asp Tyr Ile Ala Thr Ser Gln Arg Asn Pro Asp Asp
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 ccc gag tgg atg gcc cgc atc gcc gcc cac gtc gcg cgc cgc ccg aag 240
 Pro Glu Trp Met Ala Arg Ile Ala Ala His Val Ala Arg Arg Pro Lys
 65 70 75 80
 agc tgg aac acc gtg gag acc ctt gac gtg gcg cag gtg ctg tcc gac 288
 Ser Trp Asn Thr Val Glu Thr Leu Asp Val Ala Gln Val Leu Ser Asp
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 Asp Gly Ser Pro Ala Leu Val Asp Cys Leu Gly Val Trp Leu Thr Arg
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 gag ctg gac gtc acc gac gcc tgg cag cac ccg gag cag gcc cgc ccc 384
 Glu Leu Asp Val Thr Asp Ala Trp Gln His Pro Glu Gln Ala Arg Pro
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 Glu Leu Gln His Arg Ile Asp Glu Leu Ala Thr Ala Val Ala Gly Ser
 130 135 140
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 Asn Ala Ser Val Ala Asp Ala Cys Asp Glu Val Leu Leu Cys Val Ala


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Phe Asp His Val Asp Tyr Ile Ala Thr Ser Gln Arg Asn Pro Asp Asp
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Pro Glu Trp Met Ala Arg Ile Ala Ala His Val Ala Arg Arg Pro Lys
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Ser Trp Asn Thr Val Glu Thr Leu Asp Val Ala Gln Val Leu Ser Asp
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Asp Gly Ser Pro Ala Leu Val Asp Cys Leu Gly Val Trp Leu Thr Arg
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Glu Leu Asp Val Thr Asp Ala Trp Gln His Pro Glu Gln Ala Arg Pro
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Glu Leu Gln His Arg Ile Asp Glu Leu Ala Thr Ala Val Ala Gly Ser
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Pro Arg Arg Val Val Leu Val Thr Asn Glu Val Gly Ser Gly Val Val
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Pro Ala Thr Gln Ala Gly Arg Thr Phe Arg Asp Trp Leu Gly Ile Leu
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Asn Ala Ser Val Ala Asp Ala Cys Asp Glu Val Leu Leu Cys Val Ala
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 Ala Ile Ala Ser Met Pro Trp Val Gly Leu Gly Leu Gly Leu Ile Ala
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 Gly Leu Gly Cys Ala Ile Val Thr Val Ala Gly Gly Gly Gln Pro Leu
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 gca atc gca gca ggc ctg gca atc ctg gcc ctg tgc acc ggc ttc ctg 240
 Ala Ile Ala Ala Gly Leu Ala Ile Leu Ala Leu Cys Thr Gly Phe Leu
 65 70 75 80
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 His Leu Asp Gly Leu Ala Asp Thr Ala Asp Gly Leu Gly Ser Arg Lys
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 ccg gcc cac gag gcc ctg acc atc atg cgc caa tca gac atc ggg ccc 336
 Pro Ala His Glu Ala Leu Thr Ile Met Arg Gln Ser Asp Ile Gly Pro
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 Met Gly Val Thr Ala Ile Ile Leu Val Leu Ala Leu Glu Ile Ala Ala
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 Gly Gly Ser Gly His Leu Asp Gly Trp Arg Gly Val Trp Leu Leu Val
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 aca atg ccc atg gtg gcg cgc gtc agc gcc ctg tcc gcc acc gga cga 480
 Thr Met Pro Met Val Ala Arg Val Ser Ala Leu Ser Ala Thr Gly Arg
 145 150 155 160
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 Trp Ile Pro Ser Ala His Lys Lys Gly Phe Gly Ala Leu Phe Ala Gly
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 aag acg cac cct gcg acg atc gtg gtc gcc tca gtg atc gcc gcg gtg 576
 Lys Thr His Pro Ala Thr Ile Val Val Ala Ser Val Ile Ala Ala Val
 180 185 190

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 val ala val cys ala cys leu ala ser trp val phe gly val ala trp
 210 215 220
 cgc cgc cat atc ctg gcg cgg ctc gga gga ctg acc ggc gac acc ttc 720
 arg arg his ile leu ala arg leu gly gly leu thr gly asp thr phe
 225 230 235 240
 ggg tcc ctg gtc gag atg agc ggc ctg gcc tat ttg ttg acc ctg gca 768
 gly ser leu val glu met ser gly leu ala tyr leu leu thr leu ala
 245 250 255
 ttg ttc gcc tga 780
 leu phe ala

<210> 6
 <211> 259
 <212> PRT
 <213> *Propionibacterium freudenreichii*

<400> 6
 Met ala thr arg asn gly leu leu ala ala trp gly leu phe thr val
 1 5 10 15
 leu pro ala pro val val ala glu val asp glu arg leu ala val arg
 20 25 30
 ala ile ala ser met pro trp val gly leu gly leu gly leu ile ala
 35 40 45
 gly leu gly cys ala ile val thr val ala gly gly gly gln pro leu
 50 55 60
 ala ile ala ala gly leu ala ile leu ala leu cys thr gly phe leu
 65 70 75 80
 his leu asp gly leu ala asp thr ala asp gly leu gly ser arg lys
 85 90 95
 pro ala his glu ala leu thr ile met arg gln ser asp ile gly pro
 100 105 110
 met gly val thr ala ile ile leu val leu ala leu glu ile ala ala
 115 120 125
 gly gly ser gly his leu asp gly trp arg gly val trp leu leu val
 130 135 140
 thr met pro met val ala arg val ser ala leu ser ala thr gly arg
 145 150 155 160
 trp ile pro ser ala his lys lys gly phe gly ala leu phe ala gly

165										170					175				
Lys	Thr	His	Pro	Ala	Thr	Ile	Val	Val	Ala	Ser	Val	Ile	Ala	Ala	Val				
			180						185					190					
Ile	Ala	Ala	Gly	Ser	Gly	Trp	Leu	Leu	Phe	Gly	Trp	Arg	Ala	Ala	Leu				
			195				200					205							
Val	Ala	Val	Cys	Ala	Cys	Leu	Ala	Ser	Trp	Val	Phe	Gly	Val	Ala	Trp				
			210				215				220								
Arg	Arg	His	Ile	Leu	Ala	Arg	Leu	Gly	Gly	Leu	Thr	Gly	Asp	Thr	Phe				
225					230					235					240				
Gly	Ser	Leu	Val	Glu	Met	Ser	Gly	Leu	Ala	Tyr	Leu	Leu	Thr	Leu	Ala				
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Leu Phe Ala

<210> 7
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 <212> DNA
 <213> *Propionibacterium freudenreichii*

<220>
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Met	Ser	Gly	Ser	Ala	Pro	Gln	Arg	Thr	Glu	Pro	Thr	Thr	Ala	Glu	Leu	
1				5					10					15		
cgc	cac	cgc	ccc	cga	ctg	atc	gtg	aac	acc	ggg	aac	ggc	aag	ggc	aag	96
Arg	His	Arg	Pro	Arg	Leu	Ile	Val	Asn	Thr	Gly	Asn	Gly	Lys	Gly	Lys	
			20					25					30			
tcc	acc	gcc	gca	ttc	ggc	atg	gga	ctg	cgg	gcc	tgg	gcg	cag	ggc	tgg	144
Ser	Thr	Ala	Ala	Phe	Gly	Met	Gly	Leu	Arg	Ala	Trp	Ala	Gln	Gly	Trp	
		35					40					45				
tcg	atc	ggg	gtc	ttc	cag	ttc	atc	aag	tcg	gga	cgt	tgg	cac	acc	ggc	192
Ser	Ile	Gly	Val	Phe	Gln	Phe	Ile	Lys	Ser	Gly	Arg	Trp	His	Thr	Gly	
	50					55					60					
gag	cag	cag	gcc	tat	gca	cag	ctc	gac	cag	gcc	cat	cgg	acg	acc	gga	240
Glu	Gln	Gln	Ala	Tyr	Ala	Gln	Leu	Asp	Gln	Ala	His	Arg	Thr	Thr	Gly	
65					70					75					80	
gtc	ggc	gga	ccg	gtg	gaa	tgg	caa	tca	ctc	gga	tcc	ggc	tgg	tcg	tgg	288
Val	Gly	Gly	Pro	Val	Glu	Trp	Gln	Ser	Leu	Gly	Ser	Gly	Trp	Ser	Trp	
				85					90					95		
ctg	agg	gcg	acc	gag	ggc	acc	gac	cag	gca	gcc	atg	gcg	gcc	gcg	ggc	336
Leu	Arg	Ala	Thr	Glu	Gly	Thr	Asp	Gln	Ala	Ala	Met	Ala	Ala	Ala	Gly	
				100					105					110		

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tgg gcc cac gtg cgc acc ctg ctc gcc gca cag acc cac cgg ctc tac      384
Trp Ala His Val Arg Thr Leu Leu Ala Ala Gln Thr His Arg Leu Tyr
      115                      120                      125

atc ctc gac gaa ttc gcc cat gtg ctc aac aag gga tgg ctg gat gtc      432
Ile Leu Asp Glu Phe Ala His Val Leu Asn Lys Gly Trp Leu Asp Val
      130                      135                      140

gac gag gtc gct gac gac ctg gca cat cgt ccc ggc acg caa cat gtg      480
Asp Glu Val Ala Asp Asp Leu Ala His Arg Pro Gly Thr Gln His Val
      145                      150                      155                      160

gtg atc acc gga cgc aac tgc ccc gcc gga atc atc ggg atc gcc gac      528
Val Ile Thr Gly Arg Asn Cys Pro Ala Gly Ile Ile Gly Ile Ala Asp
      165                      170                      175

atc gtc acg tcc atg gac aac gtc aaa cat ccc ttt ggc aag gga gaa      576
Ile Val Thr Ser Met Asp Asn Val Lys His Pro Phe Gly Lys Gly Glu
      180                      185                      190

cga gga cag gcg ggt atc gaa tgg tga      603
Arg Gly Gln Ala Gly Ile Glu Trp
      195                      200

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<210> 8
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<212> PRT
<213> Propionibacterium freudenreichii

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Arg His Arg Pro Arg Leu Ile Val Asn Thr Gly Asn Gly Lys Gly Lys
      20                      25                      30

Ser Thr Ala Ala Phe Gly Met Gly Leu Arg Ala Trp Ala Gln Gly Trp
      35                      40                      45

Ser Ile Gly Val Phe Gln Phe Ile Lys Ser Gly Arg Trp His Thr Gly
      50                      55                      60

Glu Gln Gln Ala Tyr Ala Gln Leu Asp Gln Ala His Arg Thr Thr Gly
      65                      70                      75                      80

Val Gly Gly Pro Val Glu Trp Gln Ser Leu Gly Ser Gly Trp Ser Trp
      85                      90                      95

Leu Arg Ala Thr Glu Gly Thr Asp Gln Ala Ala Met Ala Ala Ala Gly
      100                     105                     110

Trp Ala His Val Arg Thr Leu Leu Ala Ala Gln Thr His Arg Leu Tyr
      115                     120                     125

Ile Leu Asp Glu Phe Ala His Val Leu Asn Lys Gly Trp Leu Asp Val
      130                     135                     140

Asp Glu Val Ala Asp Asp Leu Ala His Arg Pro Gly Thr Gln His Val

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145 150 155 160
 Val Ile Thr Gly Arg Asn Cys Pro Ala Gly Ile Ile Gly Ile Ala Asp
 165 170 175
 Ile Val Thr Ser Met Asp Asn Val Lys His Pro Phe Gly Lys Gly Glu
 180 185 190
 Arg Gly Gln Ala Gly Ile Glu Trp
 195 200

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<220>
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<400> 9

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 G 61

<211> 31
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<220>
 <223> Primer

<400> 10

CAGTAGATCT CGACAAGGAG GAACCCATGA G 31

<211> 30
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<220>
 <223> Primer

<400> 11

CGTAAGATCT CAGTTTCGGA CATGGCAGTG 30

<211> 24
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<220>
 <223> Primer

<400> 12

CACCACCAAC ATCGATGAGG AAAC 24

<211> 25
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<220>
<223> Primer

<400> 13

TCCAATTGGG ACTCAGTGGT CGCTG

25

<211> 39
<212> DNA
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<400> 14

CTGATATCAA TTGGAGGACA TCAGATGACC CGCATCGTC

39

<211> 28
<212> DNA
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<220>
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<400> 15

CTGAATTCCG CCACGTCAGA TCGCGTCC

28

<211> 39
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CTGATATCAA TTGGAGGACA TCAGATGACC CGCATCGTC

39

<211> 29
<212> DNA
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<220>
<223> Primer

<400> 17

CTGAATTCCG GCGGCTCAGG CGAACAATG

29